Curriculum Vitae of Luís M. A. Bettencourt

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Theoretical Division (T-7)
Los Alamos National Laboratory
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Education and Professional Experience

Los Alamos National Laboratory — Los Alamos, NM, USA
March 2003 – present
Technical Staff Member (Permanent Research Scientist)

Massachusetts Institute of Technology — Cambridge, MA, USA
December 2000 – March 2003.
Senior Postdoctoral Associate at the Center for Theoretical Physics

Los Alamos National Laboratory — Los Alamos, NM, USA
March 2000 -- March 2001.
Slansky Fellow at the Theoretical Division
This is a distinguished postdoctoral position rewarding interdisplinary research at the Theoretical Division of LANL.

Los Alamos National Laboratory — Los Alamos, NM, USA
November 1997 -- March 2000.
Director's Fellow at the Theoretical Astrophysics and Condensed Matter and Statistical Physics groups.

Heidelberg University — Heidelberg, Germany
October 1996 -- November 1997
Postdoctoral Position at the Institute for Theoretical Physics.

Imperial College, University of London — London, UK
October 1992 -- September 1996,
Ph.D. in Theoretical Physics, 31st of December 1996.
Title of Thesis: Symmetry-Breaking Phase Transitions in the Early Universe.
Supervisor: Dr. R. J. Rivers.

Instituto Superior Tecnico — Lisbon, Portugal
September 1987 -- July 1992
Undergraduate degree (5 years) in Engineering Physics
with (the equivalent of) First Class Honors.
Undergraduate dissertation: CP-Violation and B-Physics

Publications:

50. "The functional structure of cortical neuronal networks grown *in vitro*"
L. M. A. Bettencourt, G. J. Stephens, M. I. Ham, and G. W. Gross,
Submitted to Physical Review E.

49. "Detecting early human transmission of H5N1 avian influenza",
L. M. A. Bettencourt, and R. M, Ribeiro,
Submitted to Proceedings of the National Academy (USA).

48. "In-Situ Data Quality Assurance for Environmental Applications of Wireless Sensor Networks ",
L. B. Larkey, L. M. A. Bettencourt, and A. Hagberg,
Submitted to ACM Transactions in Distributed Sensor Networks.

47. "New Opportunities in Ecological Sensing using Wireless Sensor Networks",
S. L. Collins, L. M. A. Bettencourt, A. Hagberg, L. Larkey, R. F. Brown, D.I. Moore, G. Bonito, K. A. Delin, S. P. Jackson, D. W. Johnson, S. C. Burleigh, R. R. Woodrow, and J. M. McAuley,
To appear in Frontiers in Ecology and the Environment.

46. "Quantifying social *vs* anti-social behavior in email networks",
L. H. Gomes, L. M. A. Bettencourt, V. A. F. Almeida, F. D. O. Castro, J. M. Almeida,.
Submitted to Physical Review E.

45. "Growth, Innovation, scale and the pace of life in the city",
L. M. A. Bettencourt, J. Lobo, D. Helbing, C. Kühnert, and G. B. West,
Submitted to Nature.

44. "On the transmission dynamics of knowledge" ,
A. Cintron-Arias, L. M. A. Bettencourt , D. I. Kaiser, C. Castillo-Chavez, under revision.

43. "Analysis of current Marburg virus hemorrhagic fever outbreak in Angola",
L. M. A. Bettencourt, LA-UR –05-3179, under revision.

42. "Outlook for current Marburg virus outbreak in Angola",
L. M. A. Bettencourt, LA-UR 05-3178

41. "Tipping the balances of a small world",
L. M. A. Bettencourt,
Submitted to Physical Review E.

40. "From boom to bust and back again: the complex dynamics of trends and fashions"
L. M. A. Bettencourt.
Submitted to Journal of Artificial Societies and Social Simulation

39. "Invention in the city: increasing returns to scale in metropolitan pattenting",
L. M. A. Bettencourt, J. Lobo, and D. Strumsky,
Research Policy, in print.

38. "The power of a good idea: Quantitative Modeling of the Spread of Ideas from Epidemiological Models",
L. M. A. Bettencourt, A. Cintron-Arias, D. I. Kaiser, C. Castillo-Chavez,

Physica A 364 513–536 (2006).

37. "Improving Spam Detection Based on Structural Similarity"
L. H. Gomes, F. D. O. Castro, R. B. Almeida, Luis M. A. Bettencourt, Virgilio A. F. Almeida, Jussara M. Almeida.
In SRUTI: Steps to Reducing Unwanted Traffic on the Internet, July 7-8, 2005, MIT, Cambridge, MA, USA.

36. "Comparative graph theoretical characterization of networks of spam and regular email"
L. H. Gomes, R. B. Almeida, L. M. A. Bettencourt, V. A. F. Almeida, J. M. Almeida,
In CEAS 2005, July 21 & 22, at Stanford University, Stanford, CA, USA.

35. "The self-consistent bounce: an improved nucleation rate",
Y. Bergner, and L. M. A. Bettencourt,
Physical Review D 69, 045012 (2004).

34. "Dressing Up the Kink",
Y. Bergner, and L. M. A. Bettencourt,
Physical Review D 69, 045002 (2004).

33. "A step beyond the bounce: bubble dynamics in quantum phase transitions",
Y. Bergner, and L. M. A. Bettencourt,
Physical Review D 68 025014 (2003).

32. "Vortex description of the first order phase transition in the two-dimensional Abelian-Higgs model",
L. M. A. Bettencourt , and G. J. Stephens,
Phys. Rev. E 67, 066105 (2003).

31. "The role of point-like topological excitations at criticality: from vortices to global monopoles",
N. D. Antunes, L. M. A. Bettencourt , and M. Kunz,
Physical Review E 65, 066117 (2002).

30. "Relativistic hydrodynamic scaling from the dynamics of relativistic quantum field theory",
L. M. A. Bettencourt , F. Cooper and K. Pao,
Physical Review Letters 89, 112301 (2002).

29. "Critical Dynamics of gauge systems: Spontaneous vortex formation in 2D superconductors",
G. Stephens, L. M. A. Bettencourt and W. H. Zurek,
Physical Review Letters 88 137004 (2002).

28. "Dynamical behavior of spatially inhomogeneous relativistic $\lambda\phi^4$ quantum field theory in the Hartree approximation",
L. M. A. Bettencourt , K. Pao and J. Sanderson,
Physical Review D 65 025015 (2002).

27. "Langevin evolution of disoriented chiral condensates",
L. M. A. Bettencourt , K. Rajagopal and J. Steele,
Nuclear Physics A 693 825 (2001).

26. "The role of topological excitations at second order transitions".
L. M. A. Bettencourt , Invited contribution to Fluctuating Paths and Fields, Festschrift Dedicated to Hagen Kleinert on the Occasion of His 60th Birthday (World Scientific, Singapore, 2001).

25. "Properties of the Langevin and Fokker-Planck equations for scalar fields and their application to the dynamics of second order transitions".
L. M. A. Bettencourt ,
Physical Review D 63 045020 (2001).

24. "Predicting the critical density of topological defects in O(N)scalar field theories"
N. D. Antunes, L. M. A. Bettencourt, and A. Yates ,
Physical Review D 64 065020 (2001).

23. "Ginzburg regime and its effects on topological defect formation",
N. D. Antunes, L. M. A. Bettencourt and W. H. Zurek.
Physical Review D 62 065005 (2000).

22. "The electrical conductivity in high temperature QED",
L. M. A. Bettencourt , E. Mottola,
Proceedings of ``Strong and Electroweak Matter 2000'', Ed. C. Korthals-Altes.

21. "Topological excitations and second order transitions in 3D O(N) models".
L. M. A. Bettencourt , Invited lecture. In the proceedings of
"Topology of strongly correlated system", Eds. J..Bicudo et. al. (2000).

20. "Shards of broken symmetry: Topological defects as traces of the phase transition dynamics",
L. M. A. Bettencourt , W.H. Zurek, J. Dziarmaga, and N.D. Antunes.
Acta Physica Polonica B 31 2937 (2000).

19. "Controlling one-dimensional Langevin dynamics on the lattice",
L. M. A. Bettencourt , S. Habib and G. Lythe,
Physical Review D 62, 1238 (2000).

28. ``Thermal vortex dynamics in a two-dimensional condensate'',
R. Sasik, L. M. A. Bettencourt and S. Habib,
Physical Review B 82 2824 (1999).

17. "Vortex String Formation in a 3D U(1) Temperature Quench"
N. D. Antunes, L. M. A. Bettencourt and W. H. Zurek,
Physical Review Letters 82 2824 (1999).

16. "The Length Distribution of Vortex Strings in U(1) equilibrium scalar field theory",
N.D. Antunes, L. M. A. Bettencourt
Physical Review Letters 81 3083 (1998).

15. "Time Evolution of correlation function for classical and quantum anharmonic oscillators",
L. M. A. Bettencourt , C. Wetterich,
hep-ph/9805360.

14. "Time Evolution of Non-Equilibrium Correlation Functions",
L. M. A. Bettencourt, and C. Wetterich,
Physics Letters B 430 140 (1998).

13. "Thermodynamics of Cosmic String Densities in U(1) Scalar Field Theory",
N. D. Antunes, L. M. A. Bettencourt and M. Hindmarsh,
Physical Review Letters 80 908 (1998).

12. "Non-intercommuting Cosmic Strings",
L. M. A. Bettencourt , P. Laguna and R. M. Matzner,
Physical Review Letters 78 2066 (1997).

11. "Out equilibrium dynamics of quench–induced symmetry breaking and topological defect]formation",
N.D. Antunes, and L. M. A. Bettencourt.
Physical Review D 55 925 (1997).

10. "The Dynamics of Symmetry Breaking Phase Transitions",
N. D. Antunes, Luis M. A. Bettencourt.
In Proceedings of Sixth International Parallel Computing Workshop, Kawasaki, Japan, November 1996.

9. "Multiple-Scale analysis of the Quantum Anharmonic Oscillator",
C. Bender, and L. M. A. Bettencourt.
Physical Review Letters 77 4114 (1996).

8. "Multiple-Scale analysis of Quantum Systems",
C. Bender, and L. M. A. Bettencourt.
Physical Review D 54 7710 (1996).

7. "Non-equilibrium Evolution of Field Theories"
N.D. Antunes, and L. M. A. Bettencourt.
Proceedings of 5th International Parallel Computing Workshop, London, U.K., September 1995.

6. "Winding Number Correlation Functions and Cosmic String Formation",
L. M. A. Bettencourt, T.S. Evans and R. J. Rivers,
Physical Review D 53 668 (1996).

5. "Subcritical Bubbles and other Non-perturbative Configurations in the Electroweak Phase Transition",
L. M. A. Bettencourt ,
Proceedings of Fourth Workshop on Thermal Field Theories and Their Applications, Dalian, P. R. China, August 1995.

4.. "Coarse Grained Fluctuation Probabilities in the Standard Model and Subcritical Bubbles"
L. M. A. Bettencourt,
Physics Letters B 356 297 (1995).

3. "Interactions Between Local $U(1)$ Cosmic Strings: an Analytical Study",
L. M. A. Bettencourt , and R.J. Rivers.
Physical Review D 51 1842 (1995).

2. "Non-intercommuting configurations in the collisions of U(1) type I Cosmic Strings", L. M. A. Bettencourt , and T.W.B. Kibble.
Physics Letters B 332 297 (1994).

1. "The Role of Local Defects in Cosmological Phase Transitions Interacting Cosmic Strings".
L. M. A. Bettencourt ,
Proceedings of Third Workshop on Thermal field Theories and Their Applications, Banff, Alberta, Canada, August 1993.

Invited Lectures and Colloquia

1. Invited speaker at "Mathematical Models in Biology and Medicine",
Arizona State University, Tempe, AZ, February 2006.

2. Invited speaker at "Scaling in urban organization", ISCOM annual meeting, Reggio Emilia, Italy, March 2005.

3. Invited speaker "Networks of Knowledge", Session of SIAM annual meeting, Portland OR, July 2004.

4. Invited Speaker at "Social organization and scaling" international meeting of ISCOM [information society as a complex system] at the Santa Fe Institute, August 2003.

5. Invited speaker at CNLS Conference on Mathematical Epidemiology
"Computational and Mathematical Approaches to Homeland Security, Public Health Policy and Control: Challenges Posed by Emerging and Reemerging Diseases", LANL, July 2-3, 2003.

6. Invited seminar at CNLS [LANL] seminar series: "From boom to bust and back again : the complex dynamics of trends and fashions", June 2003.

7. Physics Dept. Colloquium at the University of Montreal, Canada, 18th of January 2002.

8. Invited speaker at International conference on ``Topology of strongly correlated systems", Lisbon, Portugal, Oct. 8-13, 2000.

9. Lecturer at the Los Alamos Summer School, Los Alamos, NM, June-August 2000.

In addition I have given over 40 invited seminars in leading research universities and laboratories in the USA, Canada and Europe.

Grants and Proposals

1. Principal Investigator on UNM/LANL MOU research and understanding grant "Enabling distributed network sensing of arid ecosystem adaptation resulting from global climate change".

2. Principal Investigator of LDRD - ER "Quantitative Modeling of living neuronal networks in vitro" The proposal was ranked first in the Environmental and Biological Sciences category in 2004. Budget $280K/year, includes subcontract with University of North Texas for joint experiments, and initiated there a new graduate program in

Biophysics. The first candidate Michael Ham started January 2005 and was recently awarded the "best poster" prize in neuroscience among all other graduate students at UNT.

3. Co-Pi with Aric Hagberg (T-7) for DCI postdoc proposal on "Distributed Sensor networks: enabling active uncertainty management and and learning".

4. Participant in two funded IPDs with Chris Wood, Garrett Kenyon, and John George (P-21) to develop computational neuroscientific capabilities at LANL and towards new microelectrode technology.

5. Sponsored two awarded Director Funded postdoctoral Fellowships at LANL.

6. I co-wrote, with W.H. Zurek (T6), an IHPCI proposal entitled Phase Transitions in the Early Universe and their analogues in the laboratory for the use of the bluemountain open cluster. As a result we were awarded $30K.

7. I wrote a proposal (with W.H. Zurek, T6) for a University of California Research Partnership (UCRPI) with the Group of Prof. Chiao in U.C. Berkeley, entitled “Photon superfluid as a complex adaptative medium; Critical phenomena and spatial solitons in non-linear cavities”. As a result we were awarded $55K/year per institution, for 3 years.

Other Awards and Educational Fellowships

1. Chosen (with 50 others out of over 200 applications, by essay) to participate in the Computer Research Association international conference on "Grand Research Challenges in Information Security and Assurance", Airlie House, Warrenton, Virginia, November 16-19, 2003. The conference aimed at creating the vision of the Computer Science research community of the challenges and opportunities facing computer networks over the next decades. A list of 4 "Grand Challenge" problems was produced as the result, see http://www.cra.org/Activities/grand.challenges/security/home.html

2. Awarded a Portuguese National Science Foundation (JNICT)Post-graduate Fellowship, 1992--96, to conduct Postgraduate studies leading to my PhD degree.

3. Awarded a Fellowship for Young Researchers, between 1990—92 by INIC, the Portuguese National Institute for Scientific Research, while an undergraduate at IST. The research was conducted at the Institute for Physics and Mathematics in Lisbon and resulted in my Undergraduate dissertation entitled “CP-Violation and B-Physics”.

4. Winner of Essay Competition for young Europeans (European Union wide) sponsored by the Japanese Ministry of Foreign Affairs on cooperation between Japan and E.U. Countries, August 1989. The prizes were a 20 days study trip to Japan, together with the winners from other European countries, organized by the Japanese Ministry of Foreign Affairs.

Graduate supervision and teaching experience

As part of the opportunities during my education and Postdoctoral positions I have undertaken undergraduate and more recently graduate teaching and advising:

1. Set up MSc final research project on "Decision Theory, and the dynamics of trends" for students at Imperial College, University of London, academic year 2003/04 under the

supervision of Dr. R. J. Rivers.

2. Graduate student research supervision at MIT-CTP.
Supervised Graduate student Yoav Bergner's thesis on the non-equilibrium time evolution of first order phase transitions in quantum field theory. Yoav successfully defended his thesis in August 2003.

3. Supervisor for Summer Student at LANL. This is a Summer graduate program in which students have a change to experience research at LANL. June-August 1999.

4. Tutor at B.U.S.S.T.E.P., British Universities Summer School in Theoretical High Energy Physics, University of Sussex, Falmer, U.K. September 9-24, 1997. Tutors are selected among promising senior postdocs to cover the materials in the school's syllabus. These reflect the perceived basic and new exciting fields of high energy Physics and Cosmology. My field of expertise was non-equilibrium quantum fields.

5. Teaching Assistant in Dynamical Systems and Chaos, Imperial College, London, England. October 1994-January 1995.

6. Teaching Assistant in Quantum Mechanics, Imperial College, London, England. October 1993-January 1994.

7. Teaching Assistant in Thermodynamics, Instituto Superior Tecnico, Lisbon, Portugal. February 1992-July 1992.

8. Teaching Assistant in Classical Electrodynamics
Instituto Superior Tecnico, Lisbon, Portugal. October 1991-January 1992.

I have also assisted with final examinations for Physics undergraduates at the University of Heidelberg, between October 1996 and November 1997.

Other Scientific Activities

1. Member of Editorial Board of "Mathematics in Computer Science", a new journal to be published by Birkhäuser.

2. Consultant for Department of Energy, Office of Science and Technology Information (OSTI) on "Dynamics of Scientific Innovation and Discovery".

3. Scientific Committee of "International Conference on mathematical aspects of Computer and information Sciences" (MACIS 2006), Beijing, China, July 2006.

4. Organizing Committee of "Opportunities and Challenges in Distributed Sensor Networks", LANL/CNLS March 2006.

5. I organize "Information Processing in Complex Systems" Seminar series, held at the Center for Non-Linear Science, LANL.

6. Organized the weekly T6-Tea seminars at the Theoretical Division, LANL. These are informal seminar/discussion meetings for LANL scientists (especially T6) and visitors to present and discuss their recent work.

7. Referee for Physical Review Letters, Physical Review A, Physical Review D, Physical Review E, Physics Letters A, Annals of Physics, Physics of Plasmas, Journal of Statistical Physics, Quantum and Classical Gravity , Journal of Artificial Societies and Social Simulation.

8. Scientific Secretary of School and A.S.I. in Current Topics in Astrofundamental Physics, Erice, September 1994.

9. Assistant Coordinator of A.S.I. in Electroweak Physics and The Early Universe, Sintra, March 1994.

Language Proficiency

I have native proficiency in Portuguese and English. I have fluent communication skills in Spanish, French and German, and good oral proficiency in Italian.

Algorithmic and Computational Experience

Expertise in numerical methods for Ordinary and Partial Differential Equations, stochastic systems, nonlinear dynamics, statistical inference from data, time series analyses, and graph theory.

I know Unix/Linux, OS X operating systems and Python, PERL, c, FORTRAN, HTML and several other data analysis, plotting and symbolic manipulation platforms: such as Mathematica, Maple, MATLAB, Data Explorer.